Claims

1. A suspension device (1) for the load-bearing and resilient support of a wheel (2) in a motor vehicle, comprising at least one spring cylinder (10) with a piston (14), which is guided in a manner moveable relative to it in a pressure cylinder (12), and comprising a driving device (20) for converting pivoting movements of a wheel oscillating-crank supporting arm (4), which movements oscillate about an oscillating-crank axis (8), into the relative movements between the pressure cylinder (12) and piston (14), the piston (14) acting counter to an elastically compressible spring medium (FM) in order to produce a load-bearing supporting spring force (F), characterized in that the driving device (20) is designed as a gearwheel mechanism (22).

2. The suspension device as claimed in claim 1, characterized by a damping device (50) for damping the suspension movements, the damping device (50) having, in particular, a separate circuit of a hydraulic damping medium (DM), which circuit is independent of the spring cylinder (10) and the spring medium (FM).

3. A suspension device (1) for the load-bearing and resilient support of a wheel (2) in a motor vehicle, comprising at least one spring cylinder (10) with a piston (14), which is guided in a manner moveable relative to it in a pressure cylinder (12), and comprising a driving device (20) for converting pivoting movements of a wheel oscillating-crank supporting arm (4), which movements oscillate about an oscillating-crank axis (8), into the relative movements between the pressure cylinder (12) and piston (14), the piston (14) acting counter to an elastically compressible spring medium (FM) in order to produce a load-bearing supporting spring force (F), and having a damping device (50) for damping the suspension

movements, characterized in that the damping device (50) has a separate circuit of a hydraulic damping medium (DM), which circuit is independent of the spring cylinder (10) and the spring medium (FM).

4. The suspension device as claimed in claim 3, characterized in that the driving device (20) is designed as a gearwheel mechanism (22).

5. The suspension device as claimed in claim 1, 2 or 4, characterized in that the gearwheel mechanism (22) comprises a gearwheel element (24), which is connected or can be connected to the oscillating-crank supporting arm (4), is mounted in a rotating manner about the oscillating-crank axis (8) and has at least a partial peripheral toothing, and a rack element (26) which is connected to the piston (14) or to the pressure cylinder (12).

6. The suspension device as claimed in one of claims 2 to 5, characterized in that the damping device (50) has at least one damper cylinder (70) having a damper piston (74), which is guided in a manner moveable relative to it in a cylinder (72), and at least one damper valve (52), which is connected hydraulically to the damper cylinder (70).

7. The suspension device as claimed in one of claims 2 to 6, characterized in that the damping device (50) interacts with the same driving device (20) as the/each spring cylinder (10).

8. The suspension device as claimed in claim 6 or 7, characterized in that the spring cylinder (10), on the one hand, and the damper cylinder (70), on the other hand, are driven by a common rack element (26) of the gearwheel mechanism (22).

9. The suspension device as claimed in claim 6 or 7,

characterized in that the/each spring cylinder (10) is driven by a first rack element (26) and the/each damper cylinder (70) is driven by a second rack element (26), the rack elements (26) being arranged in particular essentially parallel to each other on diametrically opposite sides of the gearwheel element (24) of the gearwheel mechanism (22).

10. The suspension device as claimed in one of claims 1 to 9, characterized by at least one additional spring cylinder (10) which is driven by the same driving device (20).

11. The suspension device as claimed in claim 10, characterized in that the additional, second spring cylinder (10) is driven in a manner acting identically with respect to the first spring cylinder (10), so that the partial supporting forces produced by the spring cylinders (10) add up to form the overall supporting force (F).

12. The suspension device as claimed in claim 10, characterized in that the additional, second spring cylinder (10) is driven in each case in an opposed manner with respect to the first spring cylinder (10), so that the overall supporting force (F) arises from the difference of two partial forces.

13. The suspension device as claimed in one of claims 1 to 12, characterized in that the spring medium (FM) is an elastically compressible liquid, such as silicone or the like, having a compressibility of at least 10% by volume, the spring medium (FM) being contained directly in the/each spring cylinder (10) and possibly in a storage reservoir (36) connected to the spring cylinder (10).

14. The suspension device as claimed in one of claims 1 to 12, characterized in that the spring medium

(FM) is contained as a gas in a hydropneumatic spring energy store (40), the/each spring cylinder (10) acting indirectly counter to the spring medium (FM) via a hydraulic medium (HM).

15. The suspension device as claimed in claim 14, characterized in that at least one damping valve (52) is arranged in the circuit of the hydraulic medium (HM).

16. The suspension device as claimed in one of claims 2 to 15, characterized in that the damping device (50) has two damper cylinders (70) having cylinder spaces (76) which can be changed in volume to the same extent in opposite directions in each case, the damping medium (DM) in each case flowing to and fro between the two cylinder spaces (76) and, in the process, via a damping valve (52) during the suspension movements.

17. The suspension device as claimed in one of claims 2 to 16, characterized in that the damping device (50) has a tank (118) which is incorporated into the damping circuit.

18. The suspension device as claimed in one of claims 1 to 17, characterized in that the gearwheel drive (22) is arranged in a housing space (78), the housing space (78) being incorporated into the damping circuit and, for this purpose, being at least partially filled with the damping medium (DM).

19. The suspension device as claimed in one of claims 1 to 18, characterized by at least one hydropneumatic spring energy store (40) having a freely moveable separating piston (44) which separates a storage space (46), which is connected hydraulically to the spring cylinder (10) and contains a hydraulic medium (HM), from a spring chamber (48) containing the

gaseous spring medium (FM).

20. The suspension device as claimed in claim 19, characterized in that the separating piston (44) can be acted upon by a counter pressure, on its side facing away from the spring chamber (48), independently of the pressure of the hydraulic medium (HM).

21. The suspension device as claimed in claim 20, characterized in that the separating piston (44) has a piston rod (94) which extends axially through the storage space (46) and, in a manner sealed by an intermediate wall (96), into a pressure space (98), it being possible for the piston rod (94) to be acted upon by the in particular pneumatic counter pressure in the pressure space (98).

22. The suspension device as claimed in one of claims 1 to 21, characterized by a hydraulic end position damping, in particular with at least one travel-dependent, hydraulic throttle device (104), which is integrated in the spring cylinder (10) and/or in the damper cylinder (70), in such a manner that a braking of the suspension movements is ensured in each case toward the end of the movement stroke before a mechanical end stop is reached.

23. The suspension device as claimed in one of claims 2 to 22, characterized in that the damping device (50) has an additional device (124) in such a manner that small suspension movements on both sides of a static position are virtually undamped while damping starts automatically only after a certain spring travel.

24. The suspension device as claimed in one of claims 2 to 23, characterized in that the damping device (50) causes a damping in the rebound direction and, if appropriate, also in the compression direction.

25. The suspension device as claimed in claim 24, characterized in that the damping cylinder (70a) is designed as a double-action piston/cylinder unit with a first pressure space (76a) and a second pressure space (76b), the pressure spaces (76a, 76b) being connected to a separate damping valve (52a, 52b) in each case.

26. The suspension device as claimed in one of claims 1 to 25, characterized by a hydraulic ride-height-adjusting device (150) in such a manner that a static vehicle ride height can be changed by feeding hydraulic medium (HM) into or letting it out from the spring circuit.

27. The suspension device as claimed in one of claims 2 to 26, characterized by a device (158) for changing the damping characteristic, it being possible for at least one adjustable damping valve (52; 52a, b) to be briefly acted upon via a switching valve (160) by an - in particular load-dependent - control pressure.